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# CGD 438

## OPTICAL INFRARED PROXIMITY FUZE

Wasserbau-Versuchsanstalt, Kochelsee G.m.b.H.

Kochel, 19 May 1945

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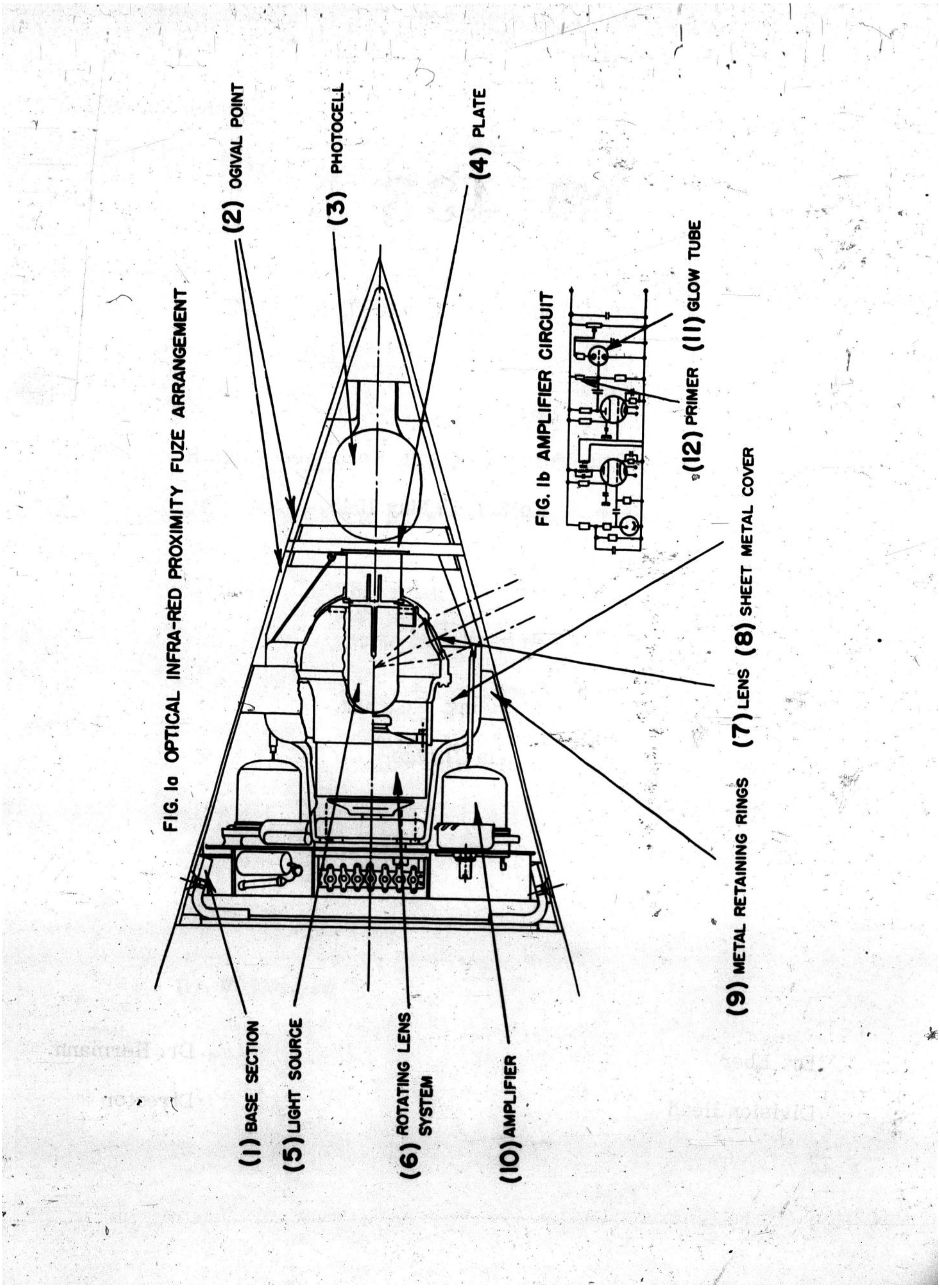


FIG. Ia OPTICAL INFRA-RED PROXIMITY FUZE ARRANGEMENT

FIG. Ib AMPLIFIER CIRCUIT

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**Abstract:** This report describes briefly an infrared proximity fuze specifically designed for use in bombs and arrow-stabilized projectiles.

**Foreward:** This memorandum is a translation of Archive No. 66/185 of the Wasserbau-Versuchsanstalt, Kochel, Germany, titled "Optischer Ultrarot-Annäherungszunder", dated 19 May 1945.

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# DESCRIPTION OF THE INFRARED OPTICAL PROXIMITY FUZE

(Drawing Z-No. 336D)

The infrared proximity fuze described in this report is a fuze specifically intended for use in arrow-stabilized projectiles and dropped bombs. Its principle of operation is as follows.

An intermittent light is produced by a lens system rotating at about 18,000 r.p.m. around a special incandescent lamp or maximum-pressure mercury lamp placed on the axis of the fuze point. Since the spinner of the lens system is equipped with six lenses, a light frequency of 1800 per second is produced. The lenses are oriented at a fixed angle -- depending upon the type of explosive material used -- and, when rotating, produce a conical light surface of high intensity. In the present case the cone angle is 130°. If the conical light surface is cut at any place upon approaching a target (for example, by the wings or fuselage of an aircraft), the light, sharply concentrated by the condensing lenses, will be scattered in all directions. One portion of the reflected light is reflected back toward the projectile to the photocell in the upper protion of the fuze. The light variations of fixed frequency are transformed by the photocell into alternating voltage of like frequency. The weak photocell signal is amplified by a two-stage tuned amplifier and used to detonate the projectile. A practically instantaneous action of the fuze results because of the great velocity of the light beam and the resulting photocurrent. The fuze may be used either day or night.

The accompanying drawing Z-No. 336D (Fig. 1) shows the longitudinal section of the fuze (Fig. 1a) and the tuned-amplifier circuit (Fig. 1b).

The optical proximity fuze is composed of a ring-formed base section (1) rigidly fastened to the projectile body, and an ogival point (2) tightly screwed to the base. The lower and upper portions of the point (2) are composed of sheet metal, while the central portion is of glass which will transmit infrared or ultraviolet light. The portion of the fuze point made of glass is composed -- contrary to the patent drawing Z-No. 355, which shows the point as a single piece -- of two conical glass surfaces separated by a non-transmitting plate (4). The photocell (3) is placed on the central axis of the upper portion of the conical surface and the light source is beneath the plate (4). This new model resulted instead of the model first announced because it was no longer possible to obtain plane photocells and tests conducted with the first

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model, which had a single piece glass nose, showed that total internal reflection onto the photocell led to misfires. This defect has been eliminated by separating the transmitter compartment from the receiver compartment by a non-transmitting plate. A special incandescent lamp (150W, 12v.) of high candle power or a maximum-pressure mercury lamp of equal capacity is used as the light source (5). The apparatus which operates the light source is located in the lower portion of the projectile and is not shown on the drawing. The light source is placed inside a rotating lens system (6), which consists of a gyro-motor with an external rotor having on its circumference a spinner with six condensing lenses.

The condensing lenses (7), at whose focal point is located the point source of light (the lamp), produce parallel beams of light. These beams are emitted at a fixed angle with respect to the projectile point (in this case 65°), and form a conical light surface when the gyro rotates. In order to make the emitted rays invisible the condensing lenses are coated to transmit only infrared or ultraviolet, depending upon which range is to be used. The lens gyro, with the stationary motor shaft, is installed in a sheet metal cover which is firmly fastened to the sheet metal surface of the point with metal rings (9). The gyro motor is fed by a frequency generator (not shown) located in the lower portion of the projectile. Since the gyro motor r.p.m. -- and the light frequency produced -- remains practically constant after the gyro has reached its maximum speed, amplification of the photocurrents produced by the photocell may be accomplished with a two-stage tuned-amplifier (10), which accepts only the light frequency produced by the lens-gyro. Therefore a premature operation of the fuze away from the target is very improbable. It is easy to change frequency at will by using a different number of lenses or by changing the generator frequency. The tuned-amplifier (10) is spring-mounted underneath the sheet metal cover (8); thus the sheet metal cover also serves as a shield between the gyro motor and the amplifier. The amplifier is shielded from external disturbances by the sheet metal point (2). The amplifier controls the grid of a glow-relay (11) or a trigger-tube in whose plate circuit is the primer (12) which ignites the explosive charge.

A fuze premature at the instant of firing (starting) is prevented by turning on the amplifier tubes only at the very instant of firing; since they are indirectly heated, sufficient emission is not reached for several seconds. Another possibility is to carry the total plate current through a small time relay which closes the plate circuit to actuate the fuze only after a preset time.

The laboratory and field tests thus far conducted have given a maximum night range of 20 meters and a maximum day range of 10 meters. The photocell used was a gas-filled semi-conducting caesium-

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cell. It was found that this cell is poorly suited for daylight use because of its high background noise level. Tests were therefore conducted with vacuum caesium cells, which gave considerably better results. It was found also that in the case of the gas-filled photocell direct incidence of sunlight reduced the sensitivity considerably more than for a vacuum cell. To avoid the interfering sunlight the photocell should be covered with a diaphragm consisting of several discs of foil or Pertinax. These tests could not be further completed. It was also intended to increase the range (which should amount to about 30 meters maximum) by enlarging the light source. A new incandescent lamp (230 W., 29.5v.) has already been developed for this purpose. Also, the light output should be increased by using condensing lenses with a diameter of 35 mm. and a focal length of 3.5 cm. in the lens-gyro instead of the lenses of 25 mm. diameter and 3.5 cm. focal length hitherto used. These new lenses would increase the area by a factor of 1.8 and give correspondingly larger light output. These tests also were carried no further.

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